


4th ANSOLE National Conference in Cameroon

(ANSOLECAM 2017)

18-19 December 2017, ENSTP Yaounde, Cameroon

A Capacity Building Event for Young Scientists

Booklet of Program & Abstracts

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BALEWARE

Third ANSOLE General Assembly in Cameroon 2017, 18 December 2017, ENSTP, Yaounde

Agenda

13:00-1400pm	Arrival and registration of participants Yaoundé
	Activities
14:00 pm	Prayer
14:05 pm	Welcome address by the Directors of ENSTP & ISPIM
14:15pm	Welcome address and presentation of the network by the International Coordinator of ANSOLE
14:35 pm	Report on ANSOLE activities in Cameroon in 2017 (ANSOLE Ngaoundere presents its activities)
14:50 pm	Launching of CAMREN activities
15:10 pm	**General Debate on:** -Launching of the ANSOLE Journal -Organization of the ANSOLECAM 2018 -Importance to be an active ANSOLE member -etc
15:50 pm	Installation by the International Coordinator of appointed ANSOLE Focal Points (AFP) and ANSOLE Young Representatives (AYR) at various universities
16:00 pm	miscellaneous
16:10 pm	Item 11
17.00 pm	Departure

Minutes of the meeting by:

1- Mr ASOBO Bertrand
2- Mr. Talla Armel

Fourth African Network for Solar Energy National Conference in Cameroon (ANSOLECAM 2017), 19 December 2017.

Advanced School of Public Works (ENSTP), Yaounde

Venue: Salle des Réunions, Bâtiment A

Programme

	Tuesday, 19th December 2017	
07: 30 am	Registration	All participants
	Opening Ceremony *moderated by ANSOLE National Representative in Cameroon*	*Dr. Claude Vidal Aloyem Kazé*
08:00 am	Welcome of President of ANSOLECAM 2017 and Director of ENSTP	Prof. George Elambo Nkeng
08:10 am	Welcome of Co-organiser of ANSOLECAM 2017 and Rector of PKFokam Institute of Excellence	Prof. Thomas Njiné
8 :15 am	Welcome of ANSOLE International Coordinator	Prof. Daniel A. M. Egbe
8 :20 am	Welcome of ANSOLE Regional Representative in Central Africa	Prof. César Kapseu
8 :30 am	Conference photograph	All
Lectures Session 1: *Photovoltaic Materials, Devices & Applications*		
Chair: Prof. César Kapseu, Examiner: Prof. Noël Djongyang, Rapporteur: Dr. Daniel Lissouck		
8:30 am	Recent advancements in organic photovoltaics: The role of non-fullerene acceptors	Daniel Ayuk Mbi Egbe, *Institute of Polymeric Materials and Testing, Johannes Kepler University Linz, Austria*
09:00 am	Angular polarization of one-dimensional photonic crystal for the formation of omni-directional reflectors: Application to thermophotovoltaic systems.	Fabrice Kwefeu Mbakop, *National Advanced Polytechnic School, University of Maroua*
09 :20 am	Feasability studies, design and optimization of photovoltaic installation for the Deuk town electrification (Mbam-and-Inoubou**)**	Aldrin Lambert Bogning *National Advanced School of Public Works of Yaoundé*
9 :40 am	Feasibility study of a solar tracking system for photovoltaic panels in the hot and cold regions of Cameroon	Roosevelt Franklin Feukjue, *University of Yaoundé I*
10 :00am	Meteorological acquisition station and experimental characterization of a mono crystalline photovoltaic module	*Yolande Ketchanji, University of Douala*
Lectures Session 2: Solar Energy and Applications		
Chair: Prof D. A. M. Egbe, Examiner: Prof. Germaine Djuidje Aloyem, Rapporteur: Dr. André Talla		
10 :20 am	Reduction des pertes post-récoltes: Mise au point et fabrication des séchoirs electriques solaires (direct, indirect) avec ou sans stockages d energie et hybride (Biomasse/solaire)	César Kapseu, *ENSAI, University of Ngaoundéré*
10:45 am	Artificial Neural Network (ANN) for predicting solar irradiation data in the North West Region of Cameroon	Claude Vidal Aloyem Kazé, *University of Bamenda*
11:05 am	**Coffee Break**	
11:30 am	Estimation of the daily distribution of the Mean Hourly Global Solar Irradiance on a horizontal surface for clear days	Mathias Bashahu, *University of Burundi, Bujumbura*

11:50 am	Model selection for calculation of solar radiation in the Sahelian zone of Cameroon	Steven Audrey Ndjanda Heugang, *University of Dschang*
12:10 am	Estimation of Surface Albedo on a Zone of the Republic of Chad, Central Africa	Zakaria Marouf Barka, *Université Adam Barka d'Abéché-TCHAD*
12:30 pm	Exergy analysis of a solar absorption refrigeration system in Ngaoundere	Armand Paiguy NGouateu Wouagfack, *HTTTC Kumba, University of Buea*
12:50 pm	Realization of a Mixed Solar Cooker for the Cooking of the Must of Sorgho (Bili-Bili)	Ango Jean M, *National Advanced Polytechnic School, University of Maroua*
13:10pm	**Lunch**	
Lectures Session 3: Wlind, Biomass & Sustainable Development		
Chair: Prof. George E. Nkeng, Examiner : Prof. Martin Kamta, Rapporteur : Dr. Alphonse MBA		
14:40 pm	A multi-sectorial approach of climate change challenge and adaptation in the Sudano-Sahelian region of Cameroon	Noël Djongyang , *National Advanced Polytechnic School, University of Maroua*
15:10 pm	Etat des besoins de la société afin de réussir les projets sur les énergies renouvelables	César Kapseu, *ENSAI, Université de Ngaoundéré*
15:30 pm	Determinants of household energy demand for cooking in Bamendankwe village, North-West Region of Cameroon.	*Bertrand Asobo Ngonla, University of Dschang*
15:50 pm	Mise en place d'un outil d'aide à la décision pour le développement de la méthanisation centralisée	Marie C. Ngono E, *ENSAI, Université de Ngaoundéré*
16:10 pm	Sliding mode control of a Brushless Doubly Fed Induction Generator in a wind Energy Conversion System	*Alix Dountio Tchioffo, Faculty of Science, University of Ngaoundéré*
16.30 pm	*influence of doping on the characteristics of zno/cds/cigs solar cells*	*Gabin Mbopda Tcheum, University of Yaounde 1*
16.50 pm	New Architecture towards Ultrathin CdTe Solar Cells for High Conversion Efficiency**.**	Ariel Teyou Ngoupo, *University of Yaoundé 1*
17:10 pm	**Award of Certificates of Participation**	**Organizing Committee**
17:30 pm	Visit of ENTSP workshops and departure	all




Participants of 3rd ANSOLE General Assembly in Cameroon and ANSOLECAM 2017

Recent Advancements in Organic Photovoltaics: The Role of Non-Fullerene Acceptors

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Abstract

Organic solar cells are designed to complement silicon based solar cells, especially in applications where flexible (and/or transparent) devices are needed. The donor-acceptor bulk heterojunction concept is known to be most efficient way to convert sunlight into electrical energy.[1] While fullerene derivatives are still the most widely used acceptor molecules for organic photovoltaic (OPV) applications, non-fullerene acceptors are on the rise.[1] Efficiencies above 13 % were recently reported.[2] This has redynamized the research interest in OPVs
This lecture provides an overview on recent advancements in OPV research by highlighting the role of non-fullerene acceptors.
Keywords: Organic photovoltaics, bulk heterojunction, non-fullerene acceptors
Acknowledgement: D. A. M. Egbe acknowledges the financial support of ANSOLE e.V.
[1] John, S. V.; Cimrova, V.; Ulbricht, C.; Pokorna, V.; Ruzicka, A.; Giguère, J.-B.; Labeur-Lambert, A.; Morin J.-F.; Iwuoha, E.; Egbe, D. A. M. *Macromolecules* **2017,** *50*, 8357-8371
[2]W Zhao, W.; Li, S.; Yao, H.; Zhang, S.; Zhang, Y.; Bei Yang, B.; Hou, J. *J. Am. Chem. Soc*. **2017**, 139, 7148−7151

Determinants of household energy demand for cooking in Bamendankwe village, North-West Region of Cameroon.

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Abstract
High dependancy on biomass has been associated with energy poverty in rural areas in Cameroon. The primary objective of this study was to analyze the determnants of energy demand for cooking among households in Bamendankwe village in the North-West Region of Cameroon. The study used the Household Budget Survey (HBS) and the research focused on the estimation of the relationship between the amount spent on energy by households, household income and characteristics of both the household and its environment. The results indicated that the determinants of the household energy demand for cooking were household monthly income, household size, educational level of family head, the proportion of women in a household, frequency of cooking delicacy and location of a household. The results also showed that each household spends an average of 14.320frs of its monthly expenditure for energy purchase. Also, it was observed that the main energy demand was the utilization of firewood which constituted 71.2% of the households and only 3% for the use of modern energy sources. This shows that most of the households donot have adequate access to environmentally-friendly modern energy sources.
The study recommend delibrate efforts by the government of Cameroon to intervene in addressing the adoption of less expensive modern cooking energy sources especially as the country has enormous potential of renewable energy. Lastly, the government should implement policies to allow access to private sector involvement in providing modern energy alternatives for cooking.
Keywords: Biomass, energy poverty, energy demand, renewable energy, household

A multi-sectorial approach of climate change challenge and adaptation in the Sudano-Sahelian region of Cameroon

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Abstract
Cameroon established an ultimate goal of making itself and emerging country (elimination of poverty, economic development, industrialization, democracy, and unified society) within the next 25-30 years, and announced "Cameroon Vision 2035", which proposes strategies to accomplish the goal. Moreover, in Cameroon's Intended Nationally Determined Contribution submitted to the UN in relation to climate change, the country declared to reduce the greenhouse gas emission by 32% compared to the 2035 reference scenario, and especially in the energy sector. It declared a total of 4,684 KtonsCO_2-eq reduction in greenhouse gas emission with a particular emphasis on the renewable energies which will account for 25% of total electricity production. The Sudano-Sahelian region of Cameroon is the most threatened by climate change. For more than a decade, actions have been taken both under governmental leadership and private initiatives to reduce the effects of global warming on the socio-economic development of the region. In this work, we will present some field study local action plans based on energy, agriculture, environmental techniques, and water management.
Key Words: Global warming; Environmental technology; Renewable Energies; Agriculture; Hydraulics and Water management; Sustainable development.

Artificial Neural Network (ANN) for Predicting Solar Irradiation Data in the North West Region of Cameroon

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Abstract
Cameroon is facing the real problem of updated data of solar irradiation to harness the existing high solar potential to solve the energy crisis in the country. The demand for solar irradiation forecasting has become a significant feature in the design of photovoltaic (PV) systems. Currently, the artificial neural network (ANN) is the most popular model that is used to estimate solar irradiation. In this work, nine models have been presented with the aim to determine the model which has lowest value of means square error and highest value of correlation coefficient. Indeed, multilayer feed-forward network with back propagation is used to forecast monthly global solar irradiation in the North West region in Cameroon which is Bamenda. Metrological and Astronomic parameters data of 240 months, collected between 1984 and 2003 are used. The parameters such as air temperature, humidity, pressure, insulation and the insulation Clearness Index are used as inputs in the ANN. The accuracy and performance of these techniques are evaluated by comparing their outputs. The analysis show that the best and accurate models include the Average Downward Longwave Radiative Flux, the Average Insulation Clearness Index, the Maximum Air Temperature at 10m Above the Surface of the Earth and the Average Air Temperature at 10m Above the Surface of the Earth.
Keywords: Solar irradiation; Levenberg-Marquard (LM) algorithm; Artificial Neural Network; Forecasting.

References

[1] E.J.K.B. Banda and J. Mubiru, "Estimation of monthly average daily global solar irradiation using artificial neural networks," *Solar Energy*, no. 82, pp. 181-187, 2008.

[2] Joseph A. Jervase, Ali Al-Lawati, and Atsu S.S. Dorvlo, "Solar radiation estimation using artificial neural networks," *Applied Energy*, no. 71, pp. 307-319, 2002.

Sliding mode control of a Brushless Doubly Fed Induction Generator in a wind Energy Conversion System

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Abstract

Wind Energy Conversion Systems (WECS) are used to produce electricity. In fact, wind is a renewable and affordable source of energy. Nowadays, most of WECS are mounted with Doubly Fed Induction Generators (DFIG). However, due to the presence of slip rings and brushes, the cost of maintenance is too high especially when the WECS are off shore [HYPERLINK \l "Ram16" **1**]. The need to use a machine which can overcome these drawbacks is necessary; hence, the trend is for BDFIGs (Brushless Doubly Fed Induction Generator)**1]}**, [HYPERLINK \l "Hen13" **2**]. Since it is necessary to ensure the good behavior of the machine and the whole system, a control strategy for the machine has to be chosen. Here, we present the non linear control of the BDFIG based on Variable Structure Control (VSC) known as Sliding Mode Control (SMC). The wind turbine is modeled and the tracking of maximum power point is assured. The Machine is modeled in the dq frame and is aligned with the power winding. Sliding mode regulators are designed to regulate both active and reactive power in the power winding of the BDFIG in order to permit a grid connection. The currents in the machine are also controlled in order to avoid the destruction of the generator due to fake currents. Simulations are carried out on Matlab-Simulink and a good behavior of the whole system is observed. This SMC control enables the system to be tolerant to the variation of some internal and external parameters of the system. The BDFIG then stands as a good candidate for new generation of wind power systems.
Keywords: Brushless Doubly Fed Induction Generator (BDFIG); sliding mode control (SMC); regulators; wind turbine.
References:
[1] Sadeghi Ramtin, Madani Seyed M., and Kashkooli M. R. Agha, "Grid Synchronization of Brushless Doubly Fed Induction Generator Using Direct Torque Control," in *7th Power Electronics, Drive Systems & Technologies Conference (PEDSTC 2016)*, Iran University of Science and Technology, Tehran, Iran, 16-18 Feb. 2016.
[2] Polinder Henk et al., "Trends in Wind Turbine Generator Systems," *IEEE Journal of Emerging and Selected Topics in Power Electronics*, vol. 1, no. 3, pp. 174-185, 2013.

Feasibility study of a solar tracking system for photovoltaic panels in the hot and cold regions of Cameroon

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Abstract

A solar tracker system is a device that keeps the photovoltaic panels perpendicular to the sun's rays. According to previous studies, solar PV tracking systems can capture 20% to 50% more solar radiation than fixed systems and the advantage of the solar tracking system is that the efficiency of photovoltaic panels is increased by 30 to 40% compared to the fixed system. The objective of this work is to evaluate the performance of the solar PV tracking system in the tropical region in particular and in Cameroon in general. This study is performed through the development of a mathematical model that allows us to evaluate, and get knowledge about the performance of solar photovoltaic tracking systems. The results obtained for the meteorological conditions of the Garoua locality (North Cameroon) and DSCHANG (West Cameroon) make it possible to propose a method that allows following the sun under clear conditions. The best inclination angle for the Pv panels in these regions for the maximum production is also proposed.

Keywords: Solar Energy, Photovoltaic, Solar tracking, Tropical regions

Estimation of the Daily distribution of the Mean Hourly Global Solar Irradiance on a Horizontal Surface for Clear Days

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Abstract

Two semi-empirical formulae are suggested in this paper to estimate the local mean hourly global solar irradiance (q(t'), in W/m^2) on a horizontal surface for clear days. The input parameters in the models calculations include the daily maximum value of the global solar irradiance (q_{max}), the latitude (φ) and longitude (L_e) of the station, the longitude (L_s) of the standard meridian close to the station, the solar declination (δ), the equation of time (E_t), the day length (t_d), the midday time (t_o') and the sunrise time (t_{sr}') in local hours. The calculated values from the proposed theoretical expressions ($q_{1,2\ theor}(t')$) are compared to the corresponding experimental data ($q_{exp}(t')$) derived from hourly global solar irradiation records at two African stations from the tropical and equatorial regions, respectively. Those data refer to twelve selected clear days in one year at each station, at the rate of one day per month.
The degree of fitting between $q_{1,2\ theor}(t')$ and $q_{exp}(t')$ data is measured through the use of three complementary statistical tests, i.e the MBE, RMSE and t-statistics. Those tests indicate good fits in all the twenty four resulting couples of curves. Moreover, the percentage maximum error (R, in %) is computed at different abscissas of the compared curves for the considered days and stations. Good results are obtained with exception for fewer extreme points.
Keywords: Clear days, diurnal variations, mean hourly global solar irradiance on a horizontal surface, semi-empirical formulae, statistical tests.

Reduction des Pertes Post-Récoltes : Mise au Point et Fabrication des Séchoirs Eectriques Solaires (Direct, Indirect) avec ou sans Stockages d Energie et Hybride (Biomasse/solaire)

César Kapseu
Ambassadeur des Sciences, Expert en Procédés et Énergies

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Résumé

En Afrique sub-saharienne, les pertes post-récolte s'élèvent à plus de 40% dans certaines activités comme les fruits et légumes. Ces pertes occasionnent des manques à gagner aux planteurs, transformateurs, distributeurs et commerçants. Afin de réduire des pertes, l'équipe de recherche dénommé : Réaction Extraction Sucrerie Séchage Huilerie (RESH) de l'Université de Ngaoundere, depuis 20 ans, a mis au point et fabriqué différents types de séchoirs. En 1997, le premier séchoir électrique a été mis au point et fabriqué avec les matériaux locaux et le petit matériel (résistance, ventilateur, régulateur) acheté sur place. Ce séchoir avait les dimensions standard (1,70 m de hauteur, 50 cm de longueur et de largeur). La capacité du séchoir est de 30 Kg sur les 10 claies. Certains séchoirs électriques déployés sur le terrain n'ont pas été suffisamment valorisés à cause de la facture électrique. Les séchoirs directs et indirects ont été conçus et fabriqués dans les années 2005. Afin de réduire les problèmes d'absence de soleil la nuit, les séchoirs solaires indirects avec stockage d'énergie ainsi que le séchoir hybride Biomasse/Solaire ont été conçus et fabriqués. Les séchoirs solaires ont eu un écho favorable à cause de l'absence de facture d'électricité. De nos jours, les expériences accumulées permettent de mettre sur pied un catalogue de petits séchoirs solaires aptes à répondre aux besoins des populations rurales.
Mots clés : séchoir solaire direct, séchoir solaire indirect, stockage d'énergie, perte post-récolte.

Angular polarization of the one-dimensional photonic crystal for the formation of omni-directional reflectors: application to the thermophotovoltaic system.

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Abstract

In this work, we demonstrate by theoretical study and then by numerical simulation the general design of the various one-dimensional photonic crystal (1D-PC) multilayer structures consisting of alternating layers of titanium dioxide (TiO_2) and calcium fluoride (CaF_2) for the first multilayer structure (TiO_2/CaF_2) then, tellurium (Te) and calcium fluoride (CaF_2) for the second structure (Te/CaF_2) to obtain omni-directional reflections which will be compared later. The Transfer Matrix Method (TMM) and Bloch's Theorem are used to determine the period and omni-directional reflection of the different 1D-PC structures presented. The omni-directional reflection of the two one-dimensional periodic structures and the analysis of the electromagnetic wave dispersion for the TE and TM modes at different angles of incidence were calculated using the Transfer Matrix Method (TMM) and the Bloch theorem. The mirrors designed with these materials are found to have an omni-directional reflection range that covers a portion of the infrared and can be applied as an optical filter used in thermophotovoltaic (TPV) conversion devices. The devise to conversion TPV directly convert radiant of the heat source into electrical energy [1-3].

Keywords: Photonic crystal, omni-directional reflection, transfer matrix method, thermophotovoltaic.

References

1.F.K. Mbakop, N. Djongyang, G.W. Ejuh, P. Woafo, D. Raïdandi, “Transmission of light through an optical filter of a one-dimensional photonic crystal: application to the solar thermophotovoltaic system”, Physica B, Elsevier 516, 92–99, 2017
2.A. Gharaati and Z. Zare, "Photonic band structures and enhancement of omnidirectional reflection bands by using a ternary 1D photonic crystal including left-handed materials", Progress In Electromagnetics Research M, Vol. 20, pp 81-94, 2011.
3.H. Oraizi A. Abdolali, "Several theorems for reflection and transmission coefficients of plane wave incidence on planar multilayer metamaterial structures", IET Microw. Antennas Propag., Vol. 4, Iss. 11, pp. 1870–1879, 2010.

Exergy analysis of a solar absorption refrigeration system in Ngaoundere

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Abstract

In this study, the first and second laws of thermodynamics are used to analyze the performance of a single-stage absorption refrigeration system powered by solar energy. The working pair used in this study is LiBr-H_2O where water (H_2O) is the refrigerant and the lithium bromide (LiBr) is the absorbent. A mathematical model based on exergy analysis [1] is applied to analyse the system performance.Temperature, enthalpy, entropy, mass flow rate and exergy loss of each component including evacuated tube solar collector are evaluated. Furthermore, the overall coefficient of performance ($COP_{cooling}$) and the overall exergetic coefficient of performance ($ECOP_{cooling}$) of the solar absorption system (absorption system coupled to an evacuated tube solar collector) for cooling purpose are calculated from the thermodynamic properties of the working fluids [2] under weather conditions of Ngaoundere city, Cameroon. The calculations were done on the basis of a half hourly analysis from 6:30 AM to 6:30 PM. The results were compared and they show that the exergy destruction highly occurs in the generator and the solar collector. The simulation results can be used for the thermodynamics optimization of solar absorption refrigeration systems.

Keywords: Refrigeration, Absorption, Exergy Analysis, Solar Collector

References

[1] Talbi, M.M. and Agnew, B. *App. Therm. Eng.* **2000**, 20, 619
[2] Ardehali, M.M. ; Shahrestani, M. and Adams, C.C. *Energ. Conv. Manag.* **2007**, 48, 864

Etat des besoins de la société afin de réussir les projets sur les énergies renouvelables

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Resumé

Afin de lancer un projet, il convient d’identifier les besoins de la société, des collectivités décentralisées et des entreprises. En ce qui concerne la region de l’Adamaoua, Il ressort que l’Elevage (bovins, volaille, Petits Ruminants), l’Agriculture, la Pisciculture, l’Aviculture, la

Transformation des produits agropastoraux, la Valorisation des déchets agropastoraux, la Pêche et la Sylviculture sont des activités principales. Les produits sur lesquels les incubateurs et la recherche développement doivent porter sont : manioc, lait, Viande, Miel, Mais, Oléagineux (Karité, Arachide). Les besoins des collectivités décentralisées portent sur les déchets : gestion et valorisation, L'eau: en quantité et en qualité, Gouvernance, Maintenance des infrastructures, Compétences techniques et le Montage des projets. Ces connaissances des besoins sont précieuses pour la réussite de tout projet en général et dans le domaine des énergies renouvelables en particulier.

Mots clés : projet, besoins, satisfaction des populations, potentialités

Estimation of Surface Albedo on a Zone of the Republic of Chad, Central Africa

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Abstract

Surface albedo is one parameter of the climate variables. It influences the surface radiation budget for a given site. The availability of surface albedo data at both temporally and spatially levels are needed. In the lack of ground recorded values of albedo, we have to estimate surface albedo from the climatic variables. The model generated in this study enables the continuous observation of land surface albedo through relative model established from the multivariate regression method.

From satellite recorded data, we estimate the ground surface albedo for some selected sites. The satisfactoy results provided the root mean square error (RMSE), the computed Mean Absolute Error (MAE) and the Mean Absolute Percentage Error (MAPE).

Keywords: albedo, solar radiation, surface temperature, relative humidity, Statistical error test, Chad.

Feasability Studies, Design and Optimization of the photovoltaic installation for the Deuk town electrification (Mbam-and-Inoubou)).

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Abstract

The excessive use of hydrocarbons by vehicles in Cameroon is a carcinogenic threat due to high traffic jams and is prominent in the distribution of petroleum's distribution stations and thermal plant sites by its emissions of fluorinated gases. In addition to the highly centralized defective transport network and electricity distribution, theexistence of large hydroelectric power stations, which are victims of climate change and a continue growing human population, are under-dimensioned to the general demand, heightened by the strategic vision "Emerging Country Horizon 2035". In the isolated area (Deuk town), the generator (oil, gasoline, fuel) is constitute the main source of electricity. Such a challenge justifies all the games on the mix of renewable energy sure and clean.A country favorable to solar energy rather conducts pilot projects to have results prior to the sustainable and effective management of solar installations instead of reassuring feasibility studies. In addition to the existing ground-based numbers of these facilities, which occupy a vast and impressive landscape, the future source of the complex housing and agricultural conflicts due to a steady growing human population (25 million estimated 2016) on a constant area at 475.660

Km2. However, the objective of this work is to carry out the ecological, technical, and economic study and then optimize the solutions. This work focus on the improvement of PV module systems of which, the performance obtained in the exploitation of sites identify by successful feasibility studies thanks to technical, environmental and economic optimization. Several softwares are used for modeling: Matlab is used to simulate the data and results of the multi-criterion optimization which minimizes the quadrupled (NBat, NPV, CT and NEo) by exploiting the LPSP (Loss of Power Supply Probability) in search of better compromises, and also to maximize the yield curves of the connection rate. Excel was also used to exploited to simulate statistical curves energy saving TEC for the variations of solar irradiation of Deuk. PVGIS used to simulate the monthly global solar irradiation and daily average data respectively. The contributions of this work indicate of the types of soils that can habour solar installations and building's types at 97% with roofs inclined at 30 ° giving the optimum yield. Some results simulated by the LPS (Loss of Power Supply) method, having Benchmark for basic model, witness the wealth to 90% of favorable natural factors (relief, vegetation and foundation). The alternative to fossil fuels provides an economic cost of 25% and the choose to orientate Deuk's electricity usage to consumption and income-generating activities produces optimum profitability by using the CER method (Capital Enrichment Rate) generating optimal investments on PV and SHS systems (Solar Home System). These achievements include the refoundation of the electrical distribution network, including the recharging stations for clean and electric vehicles. The optimized results improve the electrical efficiency which reduces light fluctuations very well and, in the case of hybrid production with electrochemical storage, an efficient management, enhanced by structured maintenance and a prospective energetic regard at the national and international level.

Keywords: feasibility, photovoltaic, design, optimization, CER, dimensioning

Realization of a Mixed Solar Cooker for the Cooking of the Must of Sorgho (Bili-Bili)

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Abstract
This work deals with the realization of a new type of solar cooker. A mixed solar cooker consisting of a parabolic reflector made using local materials. A first prototype with a reflector of 1 m diameter and fireplace of 0.24 m and a box cooker of 0.24 mx 0.24 mx 0.14 m dimensions was designed and realized. The temperature, humidity and irradiance measurements were carried out using an acquisition unit (ALMEMO) and a solar power meter. Then, a theoretical model was developed using heat transfer equations and simulated using the MATLAB software. The tests carried out for several days showed that without continuation of the sun and without regulation of the temperature inside the cooker, a maximum temperature of 95.5 °C. was obtained for a day during which the mean irradiance was 690, 13 W / m2. Without temperature regulation and with manual sun tracking, the temperature is not constant and the maximum temperature obtained in the cooker is 168 °C for an average irradiance of 716.86 W / m^2. The sorghum wort was cooked at 80 °C. for 1 h 16 min under an average irradiance of 555.52 W / m^2. The cost of the solar cooker produced is estimated at 160 000 FCFA. We will later improve this prototype by integrating automatic sun tracking and automatic temperature control devices.
Keywords: Solar energy, solar cooker, sorghum wort, regulation, solar tracker

Mise en place d'un outil d'aide à la décision pour le développement de la méthanisation centralisée

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Résumé
Dans sa volonté de contribuer au bien-être social, au développement d'opportunités économiques et à la protection de l'environnement, le Ministère de l'Environnement, de la Protection de la Nature et du Développement Durable (MINEPDED) souhaite étudier les possibilités de développement d'un projet d'implantation d'une unité de méthanisation centralisée sur le bassin versant de l'Abiergué. C'est dans cette optique que le présent travail avait pour objectif d'évaluer les potentialités de la zone d'étude pour le développement de la filière. Afin d'atteindre cet objectif, une modélisation qualitative du système de méthanisation centralisée a d'abord été effectuée permettant d'identifier les facteurs d'influence au développement de la méthanisation. L'estimation du potentiel méthanogène du gisement de chacun des onze quartiers du bassin versant de l'Abiergué a été l'étape suivante puis la cartographie et l'analyse multicritère ont été utilisées comme outils d'aide à la décision pour l'identification du site le plus propice à l'implantation de l'unité. Un bilan technico-économique préliminaire a permis d'évaluer la faisabilité économique du projet. On estime à 2 574 241 m3CH4/an, l'équivalent biogaz de la ressource organique méthanisable totale sur le bassin versant de l'Abiergué, avec une prépondérance en biodéchets des ménages (38%), des marchés (26%), en graisses de STEU (20%) et déjections animales (14%) tandis que les biodéchets de restauration et les boues de STEU représentent moins de 3% du gisement total. Le quartier Cité verte est celui ayant le potentiel méthanogène le plus élevé avec 631 311m3CH4/an. Les résultats de l'analyse multicritère, désignent par ordre de préférence, les quartiers Mokolo, Cité verte, Oyomabang, Carrière et Nkolbisson comme les cinq localités les plus propices à l'implantation d'une unité de méthanisation centralisée, tandis que les quartiers Etetack, Nkolso'o et Melen apparaissent comme les moins favorables. L'outil cartographique, quant à lui, géolocalise les zones préférentielles au voisinage des quartiers Oyomabang, Madagascar, Mokolo, Melen, cité verte et Nkolbikok. Le bilan technico-économique préliminaire indique que le capital d'investissement nécessaire à la mise en place du projet est estimé à 1 364 000 000 de fCFA et que seuls des taux de subvention à partir de 25% permettraient au projet d'atteindre des indicateurs financiers acceptables, avec un retour d'investissement établi sur 7 ans.

Mots clés : Méthanisation centralisée, Outil d'aide à la décision, Cartographie, Analyse multicritère, Potentiel méthanogène.

Model selection for calculation of solar radiation in the Sahelian zone of Cameroon

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Abstract
The purpose of this work is to develop the models, which will be used to predict the daily direct, diffuse and global solar radiation data for clear skies by combining simulations through these models, and meteorological parameters measured at the Maroua – Salack weather

station. Maroua is situated in the far – north region of the Cameroon (10°35′50″N, 14°18′57″E). Maroua is located in the Diamare plain characterized by a Sudan – Saharan climate. We used five models: *Gueymard*, *Capderou*, *Perrin & Brichambaut*, *Rsun* and *Hottel* models. The model results were assessed on the basis of a statistical test. The statistical test includes three measures namely the mean, standard deviation, standard error mean. The results obtained indicate that the proposed models can successfully be used for the estimation of the daily solar radiation data for the days considered. The detailed analysis also revealed which among the following models *Gueymard*, *Capderou*, *Perrin & Brichambaut*, *Rsun* and *Hottel* performed better solar radiation. In addition, these models can be generalized for an application of PV systems in Solar Buildings.

Keywords: Solar radiation, clear sky radiation, meteorological parameters, numerical simulation, statistic test, tilted surface models, Sahelian zone.

Meteorological Acquisition Station and Experimental Characterization of a Mono-crystalline Photovoltaic Module

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Introduction

In rural areas, more than 1.5 billion people lack access to electricity due to a fragile economy, heavy and costly infrastructure, scattered settlements, and hard-to-reach areas. Especially in sub-Saharan Africa (14.2% rural electrification rate) and especially in Cameroon where only 21.7% of rural areas were electrified in 2014. Only 4% of national energy comes from renewable energies. However, the balance of primary energy sources shows a huge dominance of renewable energies: The available hydraulic power is 13.7 GW, and the average irradiance is 4.9 kWh / day / m^2 [1].
So, how to decentralize the production of electricity and use renewable energies taking into account their seasonal availability? To answer it a good modeling of the constitutive elements is paramount. From where these works relate to our construction of a station for the acquisition of meteorological data and an experimental characterization to define powerful model of the monocrystalline photovoltaic module LW-MS50.

Principle of the acquisition station

The climatic magnitudes are acquired by three sensors, and interpreted by the computing and processing center: an Arduino Mega. Two other sensors of electrical quantities are installed at the output of the photovoltaic module. The five sensors are:

- Current sensor (ACS712-5A)
- Voltage divider bridge (1/5 resistors of 10KΩ)
- Temperature and humidity (DHT22)
- Wind speed (Adafruit Anemometer 1733)
- Irradiation (Apogee pyrometer SP-110)

The power consumed is also calculated after measuring the voltage and current of the panel. These values are displayed on a 20x4 LCD for viewing. The same measured values are saved in a 4GB memory card as a text file. Data from August and September 2017 allow this characterization.

Results

The station is installed at IUT Douala with coordinates are: 4 ° 05'57,987 " N; 9 ° 74'33,117 " E. The experimental parameters of the Benchmark model [2] are determined in the Curve Fitting Toolbox (MATLAB) and compared with the simulated diode model [3] with the

manufacturer's data. According to the model of Benchmark [2] we have: Pm = (a.G + b) .Tc + c.G + d (1)
With: Pm is the maximum power produced, Tc = Ta + [(NOCT - 20) / 800] .G (2)
(Ta: ambient temperature; NOCT: Nominal Operating cell Temperature)
Solutions: a = 0.0008483; b = 0.008136; c = 0.007458; d = 0.0637
The hypothesis of the temperature increase of the cells is verified with an undesirable effect on the electrical efficiency of the panel.

Conclusion
This experiment allowed us to verify our model with a diode and to characterize the LWMS50 by finding these coefficients according to the Benchmark model. Obtaining a model for maximum power will facilitate the optimization [4] of energy production. Future exploration is that of comparing the model to other models of literature.

Keywords: Photovoltaic, Sensor, Model, Arduino
References
[1] ERA. ENEFIBIO, Preliminary report for Cameroon. 2006.
[2] W.C. Benmoussa, et al., "Comparative study of current-voltage characteristic models of a monocrystalline silicon solar cell", Renewable Energies Review ICRESD-07 Tlemcen, 2007, 301 - 306
[3] S. Koumi. et al, "Comparison of Predictive Models for Photovoltaic Module Performance under Tropical Climate", TELKOMNIKA, Vol.10, No.2, June 2012, pp. 245-256; ISSN: 1693-6930
[4] Ho`angAnh, B. Delinchant, et al., Renewable energy supply (PV), integration with building energy management: modeling and intelligent control of electrical storage; Vietnam Academy of Science and Technology Journal of Science and Technology, 2015, 53 (6A), pp.173-187

New Architecture towards Ultrathin CdTe Solar Cells for High Conversion Efficiency.

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Abstract:
The scope of this work is to use Solar Cell Capacitance Simulator in 1 Dimension (SCAPS-1D) to investigate the possibility of realizing ultrathin CdTe based solar cells with high and stable conversion efficiency. In the first step, we modified the conventional cell structure by substituting the CdS window layer with a CdS:O film having a wide band gap ranging from 2.42 to 3.17 eV. Thereafter, we simulated the quantum efficiency, as well as the parameters of *J-V* characteristics, and showed how the thickness of CdS:O layer influences output parameters of Glass/SnO_2/ZTO/CdS:O/$CdTe_{1-x}S_x$/CdTe/Ni reference cell. High conversion efficiency of 17.30% has been found using $CdTe_{1-x}S_x$ (x = 0.12) and CdTe layers of thickness 15 nm and 4 μm, respectively. Secondly, we introduced a BSR layer between the absorber layer and back metal contact, which led to Glass/SnO_2/ZTO/CdS:O/$CdTe_{1-x}S_x$/CdTe/BSR/Ni configuration. We found that a few nanometers (about 5 nm) of $CdTe_{1-x}S_x$ layer is sufficient to obtain high conversion efficiency. For BSR layer, different materials with large band gap, such as ZnTe, Cu_2Te, and p^+-CdTe, have been used in order to reduce minority carrier recombination at the back contact. When

ZnTe is used, high conversion efficiency of 21.65% and better stability are obtained, compared to other BSR.

Keywords: SCAPS-1D, nano-CdS:O, $CdTe_{1-x}S_x$ layer, BSR layer.

References:

[1] X. Wu, "High-efficiency polycrystalline CdTe thin-film solar cells," *Solar Energy*, vol. 77, no. 6, pp. 803–814, 2004.
[2] M. A. Islam, Y. Sulaiman, and N. Amin, "A comparative study of BSF layers for ultra-thin CdS:O/CdTe solar cells," *Chalcogenide Letters*, vol. 8, no. 2, pp. 65–75, 2011.
[3] I. Clemminck, M. Burgelman, M. Casteleyn, J. de Poorter, and A. Vervaet, "Interdiffusion of CdS and CdTe in screenprinted and sintered Cds-CdTe solar cells," in *Proceedings of the Conference Record of the Twenty Second IEEE Photovoltaic Specialists Conference*, pp. 1114–1119, Las Vegas, Nev, USA, October 1991.

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